Amendments to the Specification:

Please replace the paragraph on page 4, lines 2-10, with the following amended paragraph:

The thymus is arguably the major organ in the immune system because it is the primary site of production of T lymphocytes. Its role is to attract appropriate bone marrow-derived precursor cells from the blood, and induce their commitment to the T cell lineage including the gene rearrangements necessary for the production of the T cell receptor for antigen (TCR). Associated with this is a remarkable degree of cell division to expand the number of T cells and hence ~~increase~~ <u>increases</u> the likelihood that every foreign antigen will be recognized and eliminated. This enormous potential diversity means that for any single antigen the body might encounter, multiple lymphocytes will be able to recognize it with varying degrees of binding strength (affinity) and respond to varying degrees.

Please replace the paragraph on page 11, lines 1-7, with the following amended paragraph:

The present inventors have demonstrated that thymic atrophy (~~aged induced~~ <u>age-induced,</u> or as a consequence of conditions such as chemotherapy or radiotherapy) can be profoundly reversed by inhibition of sex steroid production, with virtually complete restoration of thymic structure and function. The present inventors have also found that the basis for this thymus regeneration is in part due to the initial expansion of precursor ~~cells which~~ <u>cells, which</u> are derived both intrathymically and via the blood stream. This finding suggests that is possible to seed the thymus with exogenous haemopoietic stem cells ~~(HSC) which~~ <u>(HSC), which</u> have been injected into the subject.

Please replace the paragraph on page 11, lines 8-12, with the following amended paragraph:

The ability to seed the thymus with genetically modified or exogenous HSC by disrupting sex ~~steroid signaling~~ steroid-signaling to the thymus, means that gene therapy in the HSC may be used more efficiently to treat T cell (and myeloid cells which develop in the thymus) disorders. HSC stem cell therapy has met with little or no success to date because the thymus is dormant and incapable of taking up many if any HSC, with T cell production less than 1% of normal levels.

Please replace the paragraph on page 11, lines 22-28, with the following amended paragraph:

In certain embodiments, inhibition of sex steroid production is achieved by either castration or administration of a sex steroid ~~analogue(s)~~ analog(s). Non-limiting sex steroid ~~analogues~~ analogs include eulexin, goserelin, leuprolide, dioxalan derivatives, ~~such as~~ triptorelin, meterelin, buserelin, histrelin, nafarelin, lutrelin, leuprorelin, and luteinizing hormone-releasing hormone ~~analogues~~ analogs. In some embodiments, the sex steroid ~~analogue~~ analog is an ~~analogue~~ analog of luteinizing hormone-releasing hormone. In certain embodiments, the luteinizing hormone-releasing hormone ~~analogue~~ analog is deslorelin.

Please replace the paragraph on page 12, lines 1-4, with the following amended paragraph:

In a particular embodiment sex ~~steroid mediated~~ steroid-mediated signaling to the thymus is blocked by the administration of agonists or antagonists of LHRH, anti-

estrogen antibodies, anti-androgen antibodies, passive (antibody) or active (antigen) anti-LHRH vaccinations, or combinations thereof ("blockers").

Please replace the paragraph on page 13, lines 1-7, with the following amended paragraph:

In cases where the subject is infected with HIV, the HSC may be genetically modified such that they and their progeny, in particular T cells, macrophages and dendritic cells, are resistant to infection ~~and / or~~ and/or destruction with the HIV virus. The genetic modification may involve introduction into the HSC of one or more nucleic acid molecules which prevent viral replication, assembly and/or infection. The nucleic acid molecule may be a gene which ~~enclodes~~ encodes an antiviral protein, an antisense construct, a ribozyme, a dsRNA and a catalytic nucleic acid molecule.

Please replace the paragraph bridging pages 13 and 14, with the following amended paragraph:

The method of the present invention is particularly relevant for treatment of AIDS, where the treatment preferably involves reduction of viral load, reactivation of thymic function through inhibition of sex steroids and transfer into the patients of HSC (autologous or from a second party donor) which have been genetically modified such that all progeny (especially T cells, DC) are resistant to further HIV infection. This means that not only will the patient be depleted of HIV virus and no longer susceptible to general infections because the T cells have returned to normal levels, but the new T cells being resistant to HIV will be able to remove any remnant viral infected cells. In principle a similar strategy could be applied to gene therapy in HSC for any T cell defect or any viral infection which targets T cells.

Please replace the paragraph on page 32, lines 13-18, with the following amended paragraph:

The recipient's thymus may be reactivated by disruption of sex ~~steroid mediated signalling~~ steroid-mediated signaling to the thymus. This disruption reverses the hormonal status of the recipient. In certain embodiments, the recipient is post-pubertal. According to the methods of the invention, the hormonal status of the recipient is reversed such that the hormones of the recipient approach pre-pubertal levels. By lowering the level of sex steroid hormones in the recipient, the signalling of these hormones to the thymus is lowered, thereby allowing the thymus to be reactivated.

Please replace the paragraph on page 32, lines 19-25, with the following amended paragraph:

A non-limiting method for creating disruption of sex ~~steroid mediated signalling~~ steroid-mediated signaling to the thymus is through castration. Methods for castration include, but are not limited to, chemical castration and surgical castration. During or after the castration step, hematopoietic stem or progenitor cells, or epithelial stem cells, from the donor are transplanted into the recipient. These cells are accepted by the thymus as belonging to the recipient and become part of the production of new T cells and DC by the thymus. The resulting population of T cells recognize both the recipient and donor as self, thereby creating tolerance for a graft from the donor.

Please replace the paragraph bridging pages 34 and 35, with the following amended paragraph:

Administration may be by any method which delivers the sex ~~steroid ablating~~ steroid-ablating agent into the body. Thus, the sex ~~steroid ablating~~ steroid-ablating

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agent ~~maybe~~ may be administered, in accordance with the invention, by any route including, without limitation, intravenous, subdermal, subcutaneous, intramuscular, topical, and oral routes of administration. One non-limiting example of administration of a sex ~~steroid ablating~~ steroid-ablating agent is a subcutaneous/intradermal injection of a "slow-release" depot of GnRH agonist (*e.g.*, one, three, or four month Lupron® injections) or a subcutaneous/intradermal injection of a "slow-release" GnRH-containing implant (*e.g.*, one or three month Zoladex®, *e.g.*, 3.6 mg or 10.8 mg implant). These could also be given ~~intramuscular~~ intramuscularly (i.m.), intravenously (i.v.) or orally, depending on the appropriate formulation. Another example is by subcutaneous injection of a "depot" or "impregnated implant" containing, for example, about 30 mg of Lupron® (*e.g.*, Lupron Depot®, (leuprolide acetate for depot suspension) TAP ~~Pharmaceuticals~~ Pharmaceutical Products, Inc., Lake Forest, IL). A 30 mg Lupron® injection is sufficient for four months of sex steroid ablation to allow the thymus to rejuvenate and export new naïve T cells into the blood stream.

Please replace the paragraph bridging pages 35 and 36, with the following amended paragraph:

In some embodiments, sex steroid ablation or inhibition of sex ~~steroid signaling~~ steroid-signaling is accomplished by administering an anti-androgen such as an androgen blocker (*e.g.*, bicalutamide, trade names Cosudex® or Casodex®, AstraZeneca, ~~Aukland~~ Auckland, NZ), either alone or in combination with an LHRH analog or any other method of castration. Sex steroid ablation or interruption of sex ~~steroid signaling~~ steroid-signaling may also be accomplished by administering cyproterone acetate (trade name, Androcor®, ~~Shering~~ Schering AG, Germany; *e.g.*, 10-1000 mg, 100 mg bd or tds, or 300 mg IM weekly, a 17-hydroxyprogesterone acetate, which acts as a progestin, either alone or in combination with an LHRH analog or any

other method of castration. Alternatively, other anti-androgens may be used (*e.g.*, antifungal agents of the imidazole class, such as ~~liarozole(Liazol® e.g., 150 mg/day, an aromatase inhibitor)~~ liarozole (Liazol®, *e.g.*, 150 mg/day, an aromatase inhibitor) and ketoconazole, bicalutamide (trade name Cosudex® or Casodex®, 5-500 mg, *e.g.*, 50 mg po QID), flutamide (trade names Euflex® and Eulexin®, ~~Shering~~ Schering Plough Corp, N.J.; 50-500 mg *e.g.*, 250 or 750 po QID), megestrol acetate (Megace®) *e.g.*, 480-840 mg/day or nilutamide (trade names Anandron®, and Nilandron®, Roussel, France *e.g.*, orally, 150-300 mg/day)). Antiandrogens are often important in therapy, since they are commonly utilized to address flare by GnRH analogs. Some antiandrogens act by inhibiting androgen receptor translocation, which interrupts negative feedback resulting in increased testosterone levels and minimal loss of libido/potency. Another class of anti-androgens useful in the present invention are the selective androgen receptor modulators (SARMS) (*e.g.*, quinoline derivatives, bicalutamide (trade name Cosudex® or Casodex®, ICI Pharmaceuticals, England *e.g.*, orally, 50 mg/day), and flutamide (trade name Eulexin®, *e.g.*, orally, 250 mg/day)). Other well known anti-androgens include 5 alpha reductase inhibitors (*e.g.*, ~~dutasteride,(e.g., 0.5 mg/day)~~ dutasteride, (*e.g.*, 0.5 mg/day) which inhibits both 5 alpha reductase isoenzymes and results in greater and more rapid DHT suppression; finasteride (trade name Proscar®; ~~0.5-500mg, e.g.,~~ 0.5-500 mg, *e.g.*, 5 mg po daily), which inhibits ~~5alpha~~ 5 alpha reductase 2 and consequent DHT production, but has little or no effect on testosterone or LH ~~levels);~~ levels).

Please replace the paragraph on page 36, lines 3-24, with the following amended paragraph:

In other embodiments, sex steroid ablation or inhibition of sex ~~steroid signaling~~ steroid-signaling is accomplished by administering anti-estrogens either alone or in

combination with an LHRH analog or any other method of castration. Some anti-estrogens (*e.g.*, anastrozole (trade name Arimidex®), and fulvestrant (trade name Faslodex®) act by binding the estrogen receptor (ER) with high affinity similar to estradiol and consequently inhibiting estrogen from binding. Faslodex® binding also triggers conformational change to the receptor and down-regulation of estrogen receptors, without significant change in FSH or LH levels. Other non-limiting examples of anti-estrogens are tamoxifen (trade name Nolvadex®); Clomiphene ~~(trade name Clomid®)*e.g.*,50-250mg/day~~ <u>(trade name Clomid®) *e.g.*, 50-250 mg/day</u>, a non-steroidal ER ligand with mixed agonist/antagonist properties, which stimulates release of gonadotrophins; Fulvestrant (trade name Faslodex®; ~~10-1000mg~~ <u>10-1000 mg</u>, *e.g.*, ~~250mg~~ <u>250 mg</u> IM monthly); diethylstilbestrol ((DES), trade name Stilphostrol®) ~~*e.g.*,1-3mg/day~~ <u>*e.g.*, 1-3 mg/day</u>, which shows estrogenic activity similar to, but greater than, that of estrone, and is therefore considered an estrogen agonist, but binds both androgen and estrogen receptors to induce feedback inhibition on FSH and LH production by the pituitary, diethylstilbestrol diphosphate ~~*e.g.*,50 to 200 mg/day~~ <u>*e.g.*, 50 to 200 mg/day</u>; as well as danazol, droloxifene, and iodoxyfene, which each act as antagonists. Another class of anti-estrogens which may be used either alone or in combination with other methods of castration, are the selective estrogen receptor modulators (SERMS) (*e.g.*, toremifene (trade name Fareston®, ~~5-1000mg~~ <u>5-1000 mg</u>, *e.g.*, ~~60mg~~ <u>60 mg</u> po QID), raloxofene (trade name Evista®), and tamoxifen (trade name Nolvadex®, ~~1-1000mg~~ <u>1-1000 mg</u>, *e.g.*, ~~20mg~~ <u>20 mg</u> po bd), which behaves as an agonist at estrogen receptors in bone and the cardiovascular system, and as an antagonist at estrogen receptors in the mammary gland). Estrogen receptor downregulators (ERDs) (*e.g.*, tamoxifen (trade name, Nolvadex®)) may also be used in the present invention.

Please replace the paragraph bridging pages 36 and 37, with the following amended paragraph:

Other non-limiting examples of methods of inhibiting sex ~~steroid signalling~~ steroid-signaling which may be used either alone or in combination with other methods of castration, include aromatase inhibitors and other adrenal gland blockers (*e.g.*, Aminoglutethimide, formestane, vorazole, exemestane, anastrozole (trade name Arimidex®, ~~0.1-100mg~~ 0.1-100 mg, *e.g.*, 1 mg po QID), which lowers estradiol and increases LH and testosterone), letrozole (trade name Femara®, 0.2-500 mg, *e.g.*, ~~2.5mg~~ 2.5 mg po QID), and exemestane ~~(trade name Aromasin®)1-2000mg, e.g., 25mg/day)~~ (trade name Aromasin®, 1-2000 mg, *e.g.*, 25 mg/day); aldosterone antagonists (*e.g.*, spironolactone (trade name, Aldactone®) *e.g.*, ~~100 to 400mg/day~~ 100 to 400 mg/day), which blocks the androgen cytochrome P-450 receptor;) and eplerenone, a selective aldosterone-receptor antagonist) antiprogestogens (*e.g.*, medroxypregesterone acetate, ~~e.g. 5mg/day~~ *e.g.*, 5 mg/day, which inhibits testosterone syntheses and LH synthesis); and progestins and anti-progestins such as the selective progesterone response modulators (SPRM) (*e.g.*, megestrol acetate ~~e.g.,160mg/day~~ *e.g.*, 160 mg/day, mifepristone (RU 486, Mifeprex®, ~~e.g. 200mg/day~~ *e.g.*, 200 mg/day); and other compounds with estrogen/antiestrogenic activity, (*e.g.*, phytoestrogens, flavones, isoflavones and coumestan derivatives, lignans, and industrial compounds with phenolic ring (*e.g.*, DDT)). Also, anti-GnRH vaccines (see, *e.g.*, Hsu *et al.*, (2000) *Cancer Res.* 60:3701; Talwar, (1999) *Immunol. Rev.* 171:173-92), or any other pharmaceutical which mimics the effects produced by the aforementioned drugs, may also be used. In addition, steroid receptor based modulators, which may be targeted to be thymic specific, may also be developed and used. Many of these mechanisms of inhibiting sex ~~steroid signaling~~ steroid-signaling are well known. Each ~~drugs~~ drug may also be used

in modified form, such as acetates, citrates and other salts thereof, which are well known to those in the art.

Please replace the paragraph on page 37, lines 16-21, with the following amended paragraph:

Because of the complex and interwoven feedback mechanisms of the hormonal system, administration of sex steroids may result in inhibition of sex ~~steroid-signalling~~ steroid-signaling. For example, estradiol decreases gonadotropin production and sensitivity to GnRH action. However, higher levels of estradiol result in gonadotropin surge. Likewise, progesterone influences frequency and amount of LH release. In men, testosterone inhibits gonadotropin production. Estrogen administered to men decreases LH and testosterone, and anti-estrogen increases LH.

Please replace the paragraph bridging pages 38 and 39, with the following amended paragraph:

In some embodiments, the sex ~~steroid mediated~~ steroid-mediated signaling to the thymus is disrupted by administration of a sex steroid analog, such as an analog of leutinizing hormone-releasing hormone (LHRH). ~~Sex steroid analogs and their use in therapies and chemical castration are well known.~~ Sex steroid analogs are commercially known and their use in therapies and chemical castration are well known. Such analogs include, but are not limited to, the following agonists of the LHRH receptor (LHRH-R): buserelin (*e.g.*, buserelin acetate, trade names Suprefact® (*e.g.*, 0.5-02 mg s.c./day), Suprefact Depot®, and Suprefact® Nasal Spray (*e.g.*, 2 μg per nostril, every 8 hrs.), Hoechst, also described in U.S. Patent Nos. 4,003,884, 4,118,483, and

4,275,001); Cystorelin® (*e.g.*, gonadorelin diacetate tetrahydrate, Hoechst); deslorelin (*e.g.*, ~~desorelin~~ deslorelin acetate, Deslorell®, Balance Pharmaceuticals); gonadorelin (*e.g.*, gonadorelin hydrocholoride, trade name Factrel® (100 μg i.v. or s.c.), Ayerst Laboratories); goserelin (goserelin acetate, trade name Zoladex®, AstraZeneca, ~~Aukland~~ Auckland, NZ, also described in U.S. Patent Nos. 4,100,274 and 4,128,638; GB 9112859 and GB 9112825); histrelin (*e.g.*, ~~histerelin~~ histrelin acetate, Supprelin®, (~~s.c., 10 μg/kg.day~~ s.c., 10 μg/kg/day), Ortho, also described in EP 217659); leuprolide (leuprolide acetate, trade name Lupron® or Lupron Depot®; Abbott/TAP, Lake Forest, IL, also described in U.S. Patent Nos. ~~4,490,291~~ 4,490,291, 3,972,859, 4,008,209, 4,992,421, and 4,005,063; DE 2509783); leuprorelin (*e.g.*, ~~leuproelin~~ leuprorelin acetate, trade name Prostap SR® (*e.g.*, single 3.75 mg dose s.c. or i.m./month), Prostap3® (*e.g.*, single ~~11.25mg~~ 11.25 mg dose s.c. every 3 months), Wyeth, USA, also described in Plosker et al., (1994) Drugs 48:930); lutrelin (Wyeth, USA, also described in U.S. Patent No. 4,089,946); Meterelin® (*e.g.*, Avorelina (*e.g.*, 10-15 mg slow-release formulation), also described in ~~EP 23904 and~~ WO 91/18016); nafarelin (*e.g.*, trade name Synarel® (i.n. 200-1800 μg/day), Syntex, also described in U.S. Patent No. 4,234,571; ~~W0 93/15722~~ WO 93/15722; and ~~EP 52510~~ EP 0052510); and triptorelin (*e.g.*, triptorelin pamoate; trade names Trelstar LA® (11.25 mg over 3 months), Trelstar LA Debioclip® (pre-filled, single dose delivery), LA Trelstar Depot® (3.75 mg over one month), and Decapeptyl®, Debiopharm S.A., ~~Switserland~~ Switzerland, also described in U.S. Patent Nos. 4,010,125, 4,018,726, 4,024,121, and 5,258,492; EP 364819). LHRH analogs also include, but are not limited to, the following antagonists of the LHRH-R: abarelix (trade name Plenaxis™ (*e.g.*, 100 mg i.m. on days 1, 15 and 29, then every 4 weeks thereafter), Praecis Pharmaceuticals, Inc., Cambridge, MA) and cetrorelix (*e.g.*, cetrorelix acetate, trade name Cetrotide™ (*e.g.*, 0.25 or 3 mg s.c.), Zentaris, Frankfurt, Germany). Additional sex steroid analogs include Eulexin® (*e.g.*, flutamide (*e.g.*, 2 capsules 2x/day, total 750

mg/day), Schering-Plough Corp., also described in FR 7923545, WO 86/01105 and PT 100899), and dioxane derivatives ~~(e.g., those described in EP 413209)~~, and other LHRH ~~analogues~~ analogs such as are described in EP 181236, U.S. Patent Nos. 4,608,251, 4,656,247, 4,642,332, 4,010,149, 3,992,365, and 4,010,149. Combinations of agonists, combinations of antagonists, and combinations of agonists and antagonists are also included. One non-limiting analog of the invention is deslorelin (described in U.S. Patent No. 4,218,439). For a more extensive ~~list,~~ list of analogs, see Vickery et al. (1984) LHRH and Its Analogs: Contraceptive & Therapeutic Applications (Vickery et al., eds.) MTP Press Ltd., Lancaster, PA. Each analog may also be used in modified form, such as acetates, citrates and other salts thereof, which are well known to those in the art.

Please replace the paragraph bridging pages 42 and 43, with the following amended paragraph:

The intracellular receptors are members of the nuclear receptor superfamily. They are located in the cytoplasm of the cell and are transported to the nucleus after binding with the sex steroid hormone where they alter the transcription of specific genes. Receptors for the sex steroid hormones exist in several forms. Well known in the literature are two forms of the progesterone receptor, PRA and PRB, and three forms of the estrogen receptor, ERα, ERβ1 and ERβ2. Transcription of genes in response to the binding of the sex steroid hormone receptor to the steroid response element in the promoter region of the gene can be modified in a number of ways. Co-activators and co-repressors exist within the nucleus of the target cell that can modify binding of the steroid-receptor complex to the DNA and thereby effect transcription. The identity of many of these co-activators and co-repressors are known and methods of modifying their actions on steroid receptors are the topic of current research. Examples of the

transcription factors involved in sex steroid hormone action are NF-1, SP1, ~~Oct-1and~~ Oct-1 and TFIID. These co-regulators are required for the full action of the steroids. Methods of modifying the actions of these nuclear regulators could involve the balance between activator and repressor by the use of antagonists or through control of expression of the genes encoding the regulators.

Please replace the paragraph at page 64, lines 10-15, with the following amended paragraph:

Monitoring of T cell production is another method that may be used to determine activation of the thymus. Techniques such as flow cytometric analysis of whole peripheral blood, intracellular cytokine production, detection of new and/or proliferating cells by monitoring the markers Ki67, CD69, CD62L, LFA-1, ~~ICAM, 1,~~ ICAM-1, VCAM, VLA-4, and/or CD45 RA, as well as TREC analysis are among the methods known to those of skill in the field for such monitoring.

Please replace the paragraph at page 65, lines 6-11, with the following amended paragraph:

Animals. CBA/CAH and C57Bl6/J male mice were obtained from Central Animal Services, Monash University and were housed under conventional conditions. C57Bl6/J Ly5.1$^+$ were obtained from the ~~Central Animal Services Monash University~~ Central Animal Services, Monash University, the ~~Walterand~~ Walter and Eliza Hall Institute for Medical Research (Parkville, Victoria) and the A.R.C. (Perth, Western Australia) and were housed under conventional conditions. Ages ranged from 4-6 weeks to 26 months of age and are indicated where relevant.

Please replace the paragraph at page 70, lines 22-29, with the following amended paragraph:

The DN subpopulation, in addition to the thymocyte precursors, contains ~~(αβTCR +CD4-CD8-~~ αβTCR^{+}CD4^{-}CD8^{-} thymocytes, which are thought to have downregulated both co-receptors at the transition to SP cells (Godfrey & Zlotnik, 1993). By gating on these mature cells, it was possible to analyze the true TN compartment (CD3^{-}CD4^{-}CD8^{-}) and their subpopulations expressing CD44 and CD25. Figures 5H, 5I, 5J, and 5K illustrate the extent of proliferation within each subset of TN cells in young, old and castrated mice. This showed a significant ($p<0.001$) decrease in proliferation of the TN1 subset (CD44^{+}CD25^{-} CD3^{-}CD4^{-}CD8^{-}), from ~~~10%%~~ 10% in the normal young to around 2% at 18 months of age ~~(Fig. 5H)~~ (Fig. 5H) which was restored by 1 week post-castration.

Please replace the paragraph at page 79, lines 18-25, with the following amended paragraph:

The above findings indicate a defect in the thymic epithelium ~~rendering it~~ rendering it incapable of providing the developing thymocytes with the necessary stimulus ~~for, development~~ for development. However, the symbiotic nature of the ~~thymic, epithelium~~ thymic epithelium and thymocytes makes it difficult to ascertain the exact pathway of destruction by the sex steroid influences. The medullary epithelium requires cortical T cells for its proper development and maintenance. Thus, if this population is ~~diminished, .the~~ diminished, the medullary thymocytes may not receive adequate signals for development. This particularly seems to affect the CD8^{+} population. IRF$^{-/-}$ mice show a decreased number of CD8^{+} T cells. It would therefore, be interesting to determine the proliferative capacity of these cells.

Please replace the paragraph bridging pages 85 and 86, with the following amended paragraph:

In both irradiation and cyclophosphamide models of immunodepletion thymocyte numbers peaked at ~~every~~ two weeks and decreased four weeks after treatment. Almost immediately after irradiation or chemotherapy, thymus weight and cellularity decreased dramatically and approximately 5 days later the first phase of thymic regeneration begun. The first wave of reconstitution (days 5-14) was brought about by the proliferation of radioresistant thymocytes (predominantly double negatives) which gave rise to all thymocyte subsets (Penit and Ezine 1989). The second decrease, observed between days 16 and 22 was due to the limited proliferative ability of the radioresistant cells coupled with a decreased production of thymic precursors by the bone marrow (also effected by irradiation). The second regenerative phase was due to the replenishment of the thymus with bone marrow derived precursors (Huiskamp *et al.*, 1983).

Please replace the paragraph at page 89, lines 16-29, with the following amended paragraph:

In noncastrated mice, there was a profound decrease in thymocyte number over the 4 week time period, with little or no evidence of regeneration (Fig. 21A). In the castrated group, however, by two weeks there was already extensive thymopoiesis which by four weeks had returned to control levels, being 10 fold higher than in noncastrated mice. Flow cytometeric analysis of the thymii with respect to CD45.2 (donor-derived antigen) demonstrated that no ~~donor derived~~ <u>donor-derived</u> cells were detectable in the noncastrated group at 4 weeks, but remarkably, virtually all the thymocytes in the castrated mice were donor-derived at this time point (Fig. 21B).

Given this extensive enhancement of thymopoiesis from donor-derived haemopoietic precursors, it was important to determine whether T cell differentiation had proceeded normally. CD4, CD8 and TCR defined subsets were ~~analysed~~ analyzed by flow cytometry. There were no proportional differences in thymocytes subset proportions 2 weeks after reconstitution (Fig. 22). This observation was not possible at 4 weeks, because the noncastrated mice were not reconstituted with donor-derived cells. However, at this time point the thymocyte proportions in castrated mice appear normal.

Please replace the paragraph bridging pages 93 and 94, with the following amended paragraph:

______In order to determine if castration would enable increased chimera formation, a study was performed using syngeneic ~~foetal~~ fetal liver transplantation. The results showed an enhanced regeneration of thymii of castrated mice. These trends were again seen when the experiments were repeated using congenic (Ly5) mice. Due to the presence of congenic markers, it was possible to assess the chimeric status of the mice. As early as two weeks after ~~foetal~~ fetal liver reconstitution there were donor-derived dendritic cells detectable in the thymus, the number in castrated mice being four-fold higher than that in noncastrated mice. Four weeks after reconstitution the noncastrated mice did not appear to be reconstituted with donor derived cells, suggesting that castration may in fact increase the probability of chimera formation. Given that castration not only increases thymic regeneration after lethal irradiation and ~~foetal~~ fetal liver reconstitution and that it also increases the number of donor-derived dendritic cells in the thymus, along-side stem cell transplantation this approach increases the probability of graft acceptance.

Please replace the paragraph at page 95, lines 10-17, with the following amended paragraph:

The patient was given sex steroid ablation therapy in the form of delivery of an LHRH agonist. This was given in the form of either Leucrin (depot injection; ~~22.5mg~~ 22.5 mg) or Zoladex (implant; 10.8 mg), either one as a single dose effective for 3 months. This was effective in reducing sex steroid levels sufficiently to reactivate the thymus. In other words, the serum levels of sex steroids were undetectable (castrate; ~~<0.5ng/ml~~ ≤0.5 ng/ml blood). In some cases it is also necessary to deliver a suppresser of adrenal gland production of sex steroids. ~~Caused~~ Cosudex (~~5mg/day~~ 5 mg/day) as one tablet per day may be delivered for the duration of the sex steroid ablation therapy. Adrenal gland production of sex steroids makes up around 10-15% of a human's steroids.

Please replace the paragraph at page 95, lines 18-23, with the following amended paragraph:

Reduction of sex steroids in the blood to minimal values took about 1-3 weeks; concordant with this was the reactivation of the thymus. In some cases it is necessary to extend the treatment to a second 3 month injection/implant. The thymic expansion may be increased by simultaneous enhancement of blood HSC either as an allogeneic donor (in the case of grafts of foreign tissue) or autologous HSC (by injecting the host with G-CSF to mobilize these HSC from the bone marrow to the ~~thymus~~ thymus).

Please replace the paragraph at page 97, lines 8-24, with the following amended paragraph:

Where practical, the level of hematopoietic stem cells (HSC) in the donor blood is enhanced by injecting into the donor granulocyte-colony stimulating factor (G-CSF) at ~~10μg/kg~~ 10 μg/kg for 2-5 days prior to cell collection (*e.g.*, one or two injections of ~~10μg/kg~~ 10 μg/kg per day for each of 2-5 days). $CD34^+$ donor cells are purified from the donor blood or bone marrow, such as by using a flow cytometer or immunomagnetic beading. Antibodies that specifically bind to human CD34 are commercially available (from, *e.g.*, Research Diagnostics Inc., Flanders, NJ). Donor-derived HSC are identified by flow cytometry as being $CD34^+$. These ~~CD34+~~ $CD34^+$ HSC may also be expanded by in vitro culture using feeder cells (*e.g.*, fibroblasts), growth factors such as stem cell factor (SCF), and LIF to prevent differentiation into specific cell types. At approximately 3-4 weeks post LHRH agonist delivery (*i.e.*, just before or at the time the thymus begins to regenerate) the patient is injected with the donor HSC, optimally at a dose of about 2-4 x 10^6 cells/kg. G-CSF may also be injected into the recipient to assist in expansion of the donor HSC. If this timing schedule is not possible because of the critical nature of clinical condition, the HSC could be administered at the same time as the GnRH. It may be necessary to give a second dose of HSC 2-3 weeks later to assist in the thymic regrowth and the development of donor DC (particularly in the thymus). Once the HSC have ~~engraftment~~ engrafted (*i.e.*, have incorporated into the bone marrow and thymus), the effects should be permanent since the HSC are self-renewing.

Please replace the paragraph bridging pages 101 and 102, with the following amended paragraph:

Enzyme-linked ~~immunosorbant~~ immunosorbent assays. At various time periods pre- and post-immunization (or pre- and post- infection), mice from each group are bled, and individual mouse serum is tested using standard ~~quatitative~~ quantitative enzyme-linked ~~immunosorbant~~ immunosorbent assays (ELISA) to assess anti-HA or -NP specific IgG levels in the serum. IgG1 and IgG2a levels may optionally be tested, which are known to correlate with Th2 and Th1-type antibody responses, respectively. Briefly, sucrose gradient-purified A/PR/8/34 influenza virus is disrupted in flu lysis buffer (0.05 M Tris-HCL (pH 7.5-7.8), 0.5% ~~TritonX-100~~ Triton X-100, 0.6 M KCl) for 5 minutes at room temperature. Ninety-six well ELISA plates (Corning, Corning, NY) are coated with 200 HAU influenza in carbonate buffer (0.8 g Na_2CO_3, 1.47 g $NaHCO_3$, 500 ml ddH_20, pH to 9.6) and incubated overnight 4°C. Plates are blocked with 200 µl of 1% BSA in PBS for 1 hour at 37°C and washed 5 times with PBS/0.025% Tween-20. Samples and standards are diluted in Standard Dilution Buffer (SDB) (0.5% BSA in PBS), added to microtiter plates at 50 µl per well, and incubated at 37°C for 90 min. Following binding of antibody, plates are washed 5 times. Fifty microliters of HRP-labeled goat anti-mouse Ig subtype antibody (Southern Biotechnology Associates) is then added at optimized concentrations in SDB, and plates are incubated for 1 hour at 37°C. After washing plates 5 times, 100 µl of ABTS substrate (10 ml 0.05 M Citrate (pH 4.0), 5 ~~ul~~ µl 30% H_2O_2, 50 ~~ul~~ µl 40 mM ABTS is added. Color is allowed to develop at room temperature for 30 min., and the reaction is stopped by adding 10 µl of 10% SDS. Plates are read at $O.D._{405}$. Data are analyzed using Softmax Pro Version 2.21 computer software (Molecular Devices, Sunnyvale, CA).

Please replace the paragraph at page 106, lines 13-20, with the following amended paragraph:

The circumsporozoite protein (CSP) is a target of ~~this~~ ~~pre-erythocytic~~ pre-erythrocytic immunity ~~(Hoffman *et al.* *Science* 252: 520 (1991)~~ (Hoffman *et al.*, *Science* 252: 520 (1991)). In the *Plasmodium yoelii* (*P. yoelii*) rodent model system, passive transfer *P. yoelii* CSP-specific monoclonal antibodies (Charoenvit *et al.*, *J. Immunol.* 146: 1020 (1991)), as well as adoptive transfer of *P. yoelii* CSP-specific $CD8^+$ T cells (Rodrigues *et al.*, *Int. Immunol.* 3: 579 (1991), Weiss *et al.*, *J. Immunol.* 149: 2103 (1992)) and $CD4^+$ T cells ~~(Renia *et al.* J Immunol. 150:1471 (1993))~~ (Renia *et al.*, *J. Immunol.* 150:1471 (1993)) are protective. Numerous vaccines designed to protect mice against sporozoites by inducing immune responses against the *P. yoelii* CSP have been evaluated.

Please replace the paragraph at page 109, lines 10-19, with the following amended paragraph:

Infection and challenge. For a lethal challenge dose, the ID_{50} of *P. yoelli* sporozoites must be determined prior to experimental challenge. However, for example, it is also initially possible to inject mice intravenously in the tail vein with a dose of about 50 to 100 *P. yoelii* sporozoites (~~nonlethel~~ non-lethal, strain 17XNL). Forty-two hours after intravenous inoculation, mice are sacrificed and livers are removed. Single cell suspensions of hepatocytes in medium are prepared, and $2x10^5$ hepatocytes are placed into each of 10 wells of a multi-chamber slide. Slides may be dried and frozen at –70°C until analysis. To count the number of schizonts, slides are dried and incubated with NYLS1 before incubating with FITC-labeled goat anti-mouse Ig, and the numbers of liver-stage schizonts in each chamber are counted using fluorescence microscopy.

Please replace the paragraph at page 109, lines 20-23, with the following amended paragraph:

Once it is demonstrated that castration and/or immunization reduces the numbers of infected hepatocytes, blood smears are obtained to determine if immunization ~~protect~~ protects against blood stage infection. Mice can be considered protected if no parasites are found in the blood smears at days 5-14 days post-challenge.

Please replace the paragraph at page 110, lines 4-6, with the following amended paragraph:

Tuberculosis (TB) is a chronic infectious disease of the lung caused by the pathogen *Mycobacterium tuberculosis*, and is one of the most clinically significant infections worldwide. (see, *e.g.*, U.S.P.N. 5,736,524; for review see Bloom and Murray, 1993, Science 257, ~~1055~~ 1055).

Please replace the paragraph at page 112, lines 8-10, with the following amended paragraph:

Plasmid DNA. Suitable Ag85-encoding DNA sequences and vectors have been described previously. See, *e.g.*, U.S.P.N. 5,736,524. Other suitable expression vectors would be readily ascertainably by ~~hose~~ those skilled in the art.

Please replace the paragraph bridging pages 112 and 113, with the following amended paragraph:

Enzyme-linked ~~immunosorbant~~ immunosorbent assays. At various time periods pre- and post-immunization, mice from each group are bled, and individual mouse serum is tested using standard quantitative ELISA to assess anti-Ag85 specific IgG levels in the serum. IgG1 and IgG2a levels may optionally be tested, which are known to correlate with Th2 and Th-type antibody responses, respectively.

Please replace the paragraph at page 117, lines 9-14, with the following amended paragraph:

Any of the RevM10 gene transfer vectors known and described in the art may be used. For example, the retroviral RevM10 vector, pLJ-RevM10 is used to ~~transducer~~ transduce the HSC. The pLJ-RevM10 vector has been shown to enhance T cell engraftment after delivery into HIV-infected individuals (Ranga *et al., Proc. Natl. Acad. Sci. USA* 95:1201 (1998). Other methods of construction and retroviral vectors suitable for the preparation of GM HSC are well known in the art (see, *e.g.*, Bonyhadi *et al., J. Virol.* 71:4707 (1997)).

Please replace the paragraph at page 119, lines 17-22, with the following amended paragraph:

In this example, human cord blood (CB) HSC are collected and processed using techniques well known to those skilled in the art (see, *e.g.*, DiGusto *et al., Blood*, 87:1261 (1997), Bonyhadi *et al., J. Virol.* 71:4707 (1997)). A portion of each CB sample is HLA ~~phonotyped~~ phenotyped, and the $CD34^+$ donor cells are purified from the donor blood (or bone marrow), such as by using a flow cytometer or immunomagnetic beading,

essentially as described above. Donor-derived HSC are identified by flow cytometry as being $CD34^+$.

Please replace the paragraph at page 120, lines 10-12, with the following amended paragraph:

In this example, $CD34^+$-enriched HSC undergo transfection by a linearized RevM10 plasmid utilizing particle-mediated ~~("gene gun" transfer)~~ ("gene gun") transfer essentially as described in Woffendin *et al., Proc. Natl. Acad. Sci. USA*, 93:2889 (1996).